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Improving Core Skills in Apprentice Education

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ABSTRACT

Many Motor trade apprentice students enter the later years of their studies ill prepared for the level of the material encountered. This is due to several factors including the level of mathematics they have on leaving school. A lot of basic material has been covered during earlier years of their training but by the time they reach the third year of their apprenticeship (Phase 6) it is not safe to assume that they have a full grasp of the basics required. I have developed a diagnostic test to measure the level of preparedness of these students. This test covers basic mathematics, science and engine technology.

In addition to this the diagnostic test also forces students to revise and master the basics from their earlier years. Along with the test a series of online resources have also been provided to the students.

In this paper the test is outlined in detail. We enumerate the problem areas encountered by students studying mathematics and related subjects and suggest possible improvements that could be made by this initiative.

INTRODUCTION

In Ireland students may enter an apprenticeship once they have obtained a minimum of five passes at junior stage second level education and are over a minimum age. Mathematics is one subject studied at junior stage second level but it is not compulsory to pass this subject in order to enter into an apprenticeship. Therefore after beginning their apprenticeship and reaching off-the-job training apprentices may discover that any past mathematical weakness will resurface.

During their apprenticeship both the level and standard of mathematics increases as apprentices progress through their periods of off the job training. This is particularly a problem at phase 6 level (see below). Phase 6 is the highest level that an apprenticeship maybe studied in Ireland at off the job level. Therefore the level of mathematics at this level is also high.

In general apprentice students struggle with mathematics at phase 6 for the following reasons :

1. It has been possibly one to two years since they last studied the subject during their last off the job training course/phase 4.
2. The level and standard of mathematics increases during an apprenticeship.
3. Problems with mathematics encountered during second level education re-surface.

This test should be seen as part of a two-part process. Firstly it is used by apprentices as a revision tool in order to revise mathematical type questions and help prepare them for similar course work during their phase 6 off the job training. Secondly it allows both mathematical as well as apprentice educators in general to gather efficiently information relating to apprentice weaknesses in the area of mathematics resulting in prompt and effective follow-up in order to deal with both individual weaknesses and those of the whole cohort.

IRISH APPRENTICESHIP MODEL

Apprenticeship is the recognized means by which people are trained to become craftspeople in Ireland. The main craft trades in Ireland have been designated by FAS which is the national training authority in Ireland and come within the scope of the Statutory Apprenticeship system, which is organized in Ireland by FAS in co-operation with the Department of Education and skills, employers and unions. The apprenticeship certification and awarding body in Ireland is FETAC (Further Education and Training Council).

Apprenticeship in Ireland is a demand-driven, workplace and classroom, educational and training program for employed people aimed at developing the skills of the apprentice to meet the needs of industry and the labour market. The curriculum for each apprenticeship program is based on uniform, pre-specified standards which are agreed and determined by industry. On successful completion of an apprenticeship a FETAC Advanced Certificate is awarded, this is recognized internationally as the requirement for craftsperson status.

The Irish apprenticeship system is a modular standards-based system that was introduced in the mid 1990s having succeeded the previous day release scheme and generally comprises of seven alternating phases as listed in table 1 below.

Phase	Description of phase
Phase 1	On the job
Phase 2	Off the job (20 weeks)
Phase 3	On the job
Phase 4	Off the job (10 weeks)
Phase 5	On the job
Phase 6	Off the job (10 weeks)
Phase 7	On the job

Table 1 : Seven phases of the Irish apprenticeship system

In total the duration of the apprenticeship including both on-the-job as well as off-the-job training is generally four years. The off-the-job phases of the apprenticeship are conducted in one of several regionally located training centres or alternately in an Institute of Technology.

The Irish apprenticeship cycle is deemed to be complete when an apprentice has served the minimum timeframe from the date of registration and has successfully completed all of the alternating on-the-job and off-the-job phases of their apprenticeship. Successful completion of an apprenticeship is a compulsory requirement in order to be awarded the FETAC Advanced Certificate.

IRISH APPRENTICESHIP MODEL VERSUS GERMAN MODEL

There are several apparent differences between the Irish and German apprenticeship model. In Ireland apprentices are paid the agreed industrial apprentice wage rate by the employer. The actual amount paid may vary depending on the occupation and employer. Generally rates are based on the year and increase during the apprenticeship. During off-the-job training, all apprentices are paid an apprentice allowance by FAS and, where appropriate, a contribution towards travel or accommodation costs. There are also grants to encourage employers to recruit and register female apprentices.

The modular based Irish apprenticeship system generally comprises of seven alternating phases of on-the-job and off-the-job training and development the duration of which is generaly four years. The duration of the three off-the-job training phases does not normally exceed forty week. The first period known as phase 2 is usually twenty weeks duration and can be provided by FAS in one of their regionally located training centres or at an Institute of Technology.

Both the second and third periods, phase 4 and phase 6 are both ten weeks in duration and are normally provided by Institutes of Technology.

The German apprenticeship system has its origins in the 500-year-old crafts guilds of the Middle Ages. It allows school leavers to gain practical experience in the profession of their choice, enables them to obtain theoretical knowledge of the profession and to obtain a certificate officially qualifying them for the profession.

If deciding to learn a profession through an apprenticeship, the individual must seek out an employer who will train them throughout the apprenticeship. German apprentices usually spend three or four days a week in industry learning a craft and one or two days in technical school or in some instances they attend technical school in block intervals duration being one week per month. This apprenticeship model is sometimes referred to as the dual system because it combines supervised work experience with part-time schooling. During an apprenticeship the trainee receives an allowance paid to them by their employer. This usually goes up every year with increasing experience.

In Germany an apprenticeship generally lasts for three years. At the end of this time period during which the training received meets standards agreed upon by employers and unions the German trainee takes a national exam and if successful secures a certificate of mastery recognized throughout the country. Individual German states fund the vocational schools and the companies that take part in the nationwide program spend about 2% of payroll on it.

More than 50% of German apprentices remain employed with the companies that provided their training. Firms are not required to hire their apprentices, but many companies see an advantage in hiring employees whose personal characteristics and technical skills are known to them.

After completing their apprenticeship and working for several years, former apprentices can take additional instruction and pass another set of exams to become a “master”. They generally train other apprentices, and may own small businesses.

DUBLIN INSTITUTE OF TECHNOLOGY

The Dublin Institute of Technology was established as an autonomous institution under the Dublin Institute of Technology act in 1992 which brought together six separate colleges located in the Dublin area the origins of which may be traced back to 1887 and the establishment of technical education in Ireland.

The Dublin Institute of Technology is the largest third-level institution in Ireland with some 10,000 full time students studying undergraduate courses at higher certificate, ordinary and honours degree level as well as post graduate students pursuing courses at diploma, masters and doctoral level. A further 10,000 part-time students pursue courses ranging from apprenticeship to post graduate doctoral level.

Today the Institute continues to build on its solid foundations and to respond to the social, cultural and educational needs of Ireland in the 21st century.

LIGHT VEHICLE MECHANIC COURSE

The course I teach on is entitled Light Vehicle Mechanic. I teach it at phase 6 level and it is ten weeks in duration including assessments. The content is a mix of 50% theory based classroom work and 50% workshop/lab work. The course requires apprentices to study six different modules as listed in table 2 below. At the end of the ten week period they will be assessed in these same areas.

Module	Module Title
Module 1	Petrol Engine Management
Module 2	Steering and Suspension
Module 3	Braking Systems
Module 4	Transmission Systems
Module 5	Body Electrics
Module 6	Diesel Systems

Table 2 : Light vehicle mechanic course modules

TEST DESCRIPTION

The online test is constructed from ten different sub areas of the course having a mathematical/calculation type content. A bank of questions have been generated and computer software generates at random one question from each sub area. As well as the online test a series of online course materials relating to the test topics have also been developed as an aid to students. These are available on request from the author. The online test has ten questions in total. Table 3 below lists the topics covered by the online test.

Question	Topic
1	Binary Numbers
2	Specific Heat Capacity
3	Compression Ratios
4	Gear Ratios
5	Percentages
6	Adding Fractions
7	Ratios
8	Ohms Law
9	Electrical Power
10	Electrical Circuits

Table 3 : Test question numbers and topics covered

See appendix below

FUTURE WORK

In order to enter into an apprenticeship in Ireland a qualification in mathematics is not essential. Therefore at the beginning of the off the job stage of the apprenticeship many apprentices find that any past mathematical weakness resurface. Apart from this the level and standard of mathematics increases as apprentices progress through their periods of off the job training.

I propose that the diagnostic test outlined above focusing on the areas of mathematics and science is to be given to all apprentices on the Light vehicle mechanic course when they enter their off the job training at phase 6 level in September 2011.

The results of this test should then indicate to educator's students that may encounter difficulty with mathematical related subjects. I propose that the same test be repeated mid way through the same course in order to review students progress.

A more difficult test should then be developed. Such a test should be based on the original test, but with a number of additional questions, in order to better identify those at risk prompting educators into taking sufficient and effective follow-up action in order to deal with such individuals.

Similar tests could then be developed for phase 2 and phase 4 of the apprenticeship cycle.

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www.fas.ie

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APPENDIX

Question 1

Indicate from the options listed below the correct answer to the following question :

Binary number 110 converted into decimal is :

A = 2

B = 4

C = 6

D = 8

Question 2

Indicate from the options listed below the correct answer to the following question :

The water pump of a certain engine cooling system circulates coolant at a rate of 15 litres per minute. The inlet temperature at the cooling system radiator is 97ºC and the outlet temperature at the cooling system radiator is 85ºC. Calculate the amount of heat energy passed to the coolant in one minute ?

Assume 1 litre of coolant = 1 Kg

Take specific heat capacity for coolant as 4200 J/Kg ºC

Note

You should use the formula provided below.

Energy = Mass x Temperature Change x Specific Heat Capacity

A = 756000 KJ

B = 75600 J

C = 756 J

D = 756 KJ

Question 3

Indicate from the options listed below the correct answer to the following question :

Calculate the compression ratio of an engine using the following information in order to calculate your answer :

$\pi = \frac{22}{7}$ Bore = 10.5 cm Stroke = 10 cm

combustion chamber clearance volume = 39.775 cm^3

A = 21.7 : 1

B = 22.7 : 1

C = 12.7 : 1

D = 14.7 : 1

Question 4

Indicate from the options listed below the correct answer to the following question :

If the crown wheel rotates at a speed of 185 rpm and the outer half shaft rotates at a speed of 191 rpm, what is the speed of the inner half shaft ?

A = 179 rpm

B = 189 rpm

C = 199 rpm

D = 191 rpm

Question 5

In a sample of components 2.3% were rejected. If a total of 46 are rejected, the number in each batch is

A = 460

B = 2000

C = 20

D = 200

Question 6

Is 1/2 + 2/3 equal to

A = 7/6

B = 6/7

C = 3/7

D = 3/6

Question 7

An alloy contains copper, zinc and nickel in the ratio 2 : 3 : 5. The mass of zinc in 20 kg of the alloy is

A = 5 kg

B = 6 kg

C = 8 kg

D = 7 kg

Question 8

If a circuit is supplied by 14.4 volts has a resistance of 4 ohms is the current flow :

A = 4 amps

B = 0.36 amps

C = 36 amps

D = 3.6 amps

Question 9

If a glow plug draws 18 amps when first switched on and its resistance is 0.75 ohms how much power will it consume :

A = 243 watts

B = 24.3 watts

C = 2.43 watts

D = 2430 watts

Question 10

If three 4 ohm resistors are placed in a series circuit that is supplied with 12 volts then the current flow in the circuit will be :

A = 1 amp

B = 4 amps

C = 12 amps

D = 11 amps